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## On *Cypraea tigris schilderiana* CATE

by

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(Plate 8 and 2 Textfigures)

*Cypraea tigris schilderiana* from the Hawaiian Islands has recently been described by Cate (1961b). The purpose of this paper is to contribute further measurements and records of *C. tigris* both in the Hawaiian Islands and elsewhere in the Pacific, and to suggest three matters which merit further consideration: 1) the possible existence of *C. tigris schilderiana* outside the Hawaiian Islands; 2) the difference in habitat exhibited by *C. tigris* in the Hawaiian Islands and elsewhere in the Pacific; and 3) the variability in size of the subspecies within the Hawaiian chain of islands.

Shell measurements of *Cypraea tigris* were obtained from material in the Bernice P. Bishop Museum in Honolulu, and from numerous private collections in the State of Hawaii. A detailed geographical analysis of the specimens examined is summarized in Table 1. Measurements of length, breadth, and height were made to the nearest millimeter with vernier calipers, and the means and standard deviations for these measurements calculated. The shells were separated into three groups: 1) those from the Hawaiian Islands; 2) those from Johnston Island; and 3) those from other Pacific areas. The 75 percent rule for subspecies as set forth by Mayr, Linsley, and Usinger (1953) was applied by use of calculations of the coefficient of difference.

Figure 1 (see Plate 8), a length-frequency histogram, shows that whereas specimens of *Cypraea tigris* throughout the Pacific range in length between 51 and 147 mm., the majority of Hawaiian examples is longer than 100 mm., and the majority of those from other areas of the Pacific, with the exception of Johnston Island, is less than 100 mm. in length. Of the 403 individuals measured, only two specimens from the Hawaiian Islands were less than 95 mm. in length, and only nine from other Pacific areas excluding Johnston Island were greater than 95 mm. in length. The mean length of the Hawaiian specimens measured was 117 mm.; the mean length of those from other Pacific areas excluding Johnston Island was 77 mm.

The difference in size between specimens of *Cypraea tigris* from the Hawaiian Islands and Johnston Island, and those from elsewhere in the Pacific is further emphasized by comparisons of breadth and height (Table 1).

The figures for the coefficient of difference for the three linear dimensions of 1.9 for length, 1.9 for breadth, and 2.0 for height indicate that 95 percent of the Hawaiian population is different from the Pacific population (excluding Johnston Island) for these dimensions. Following Mayr, Linsley, and Usinger (1935), the Hawaiian population, considered only from the

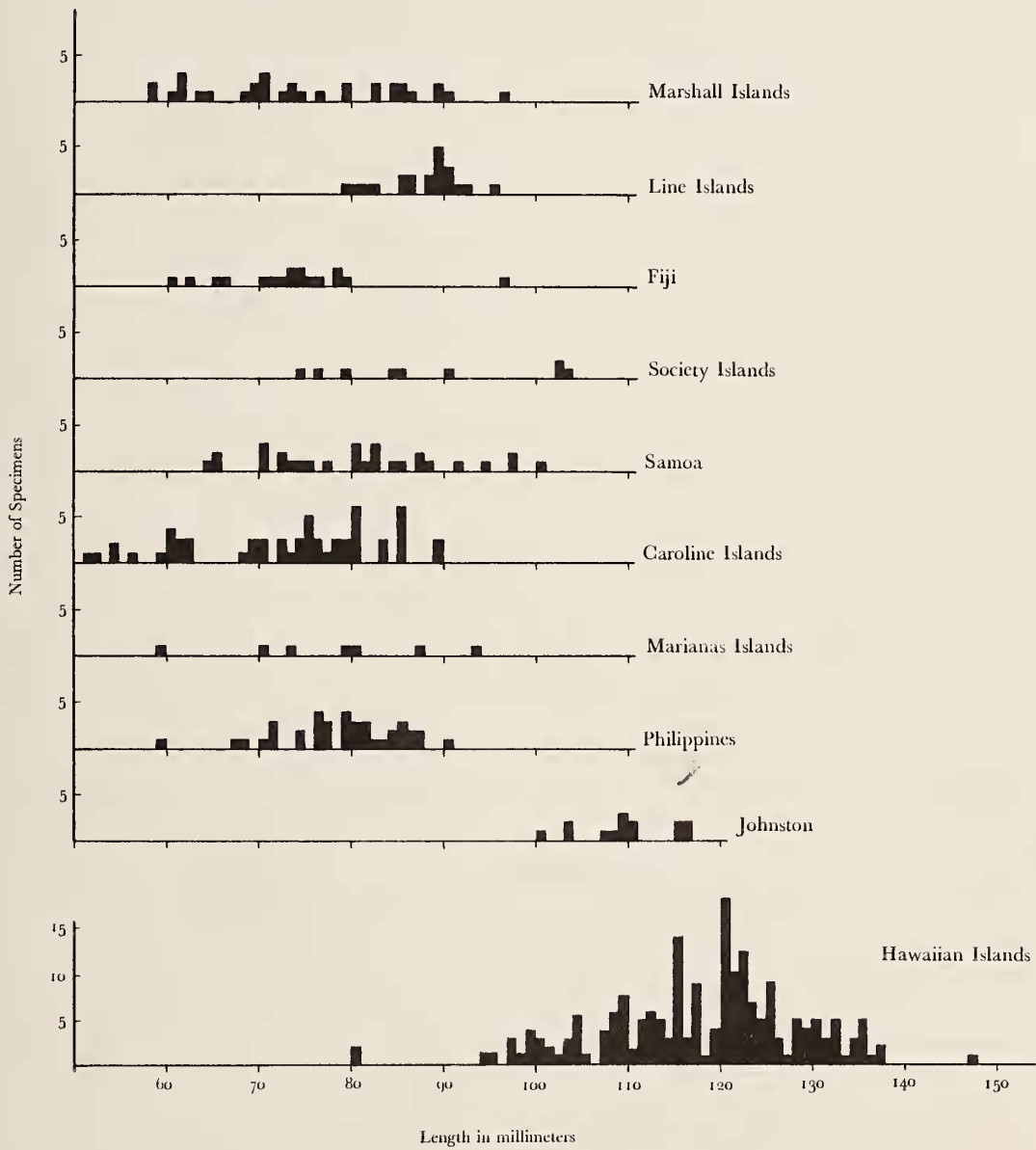


Figure 1: Length-frequency histogram showing the variations in size of *Cypraea tigris* in the Hawaiian Islands and other Pacific areas

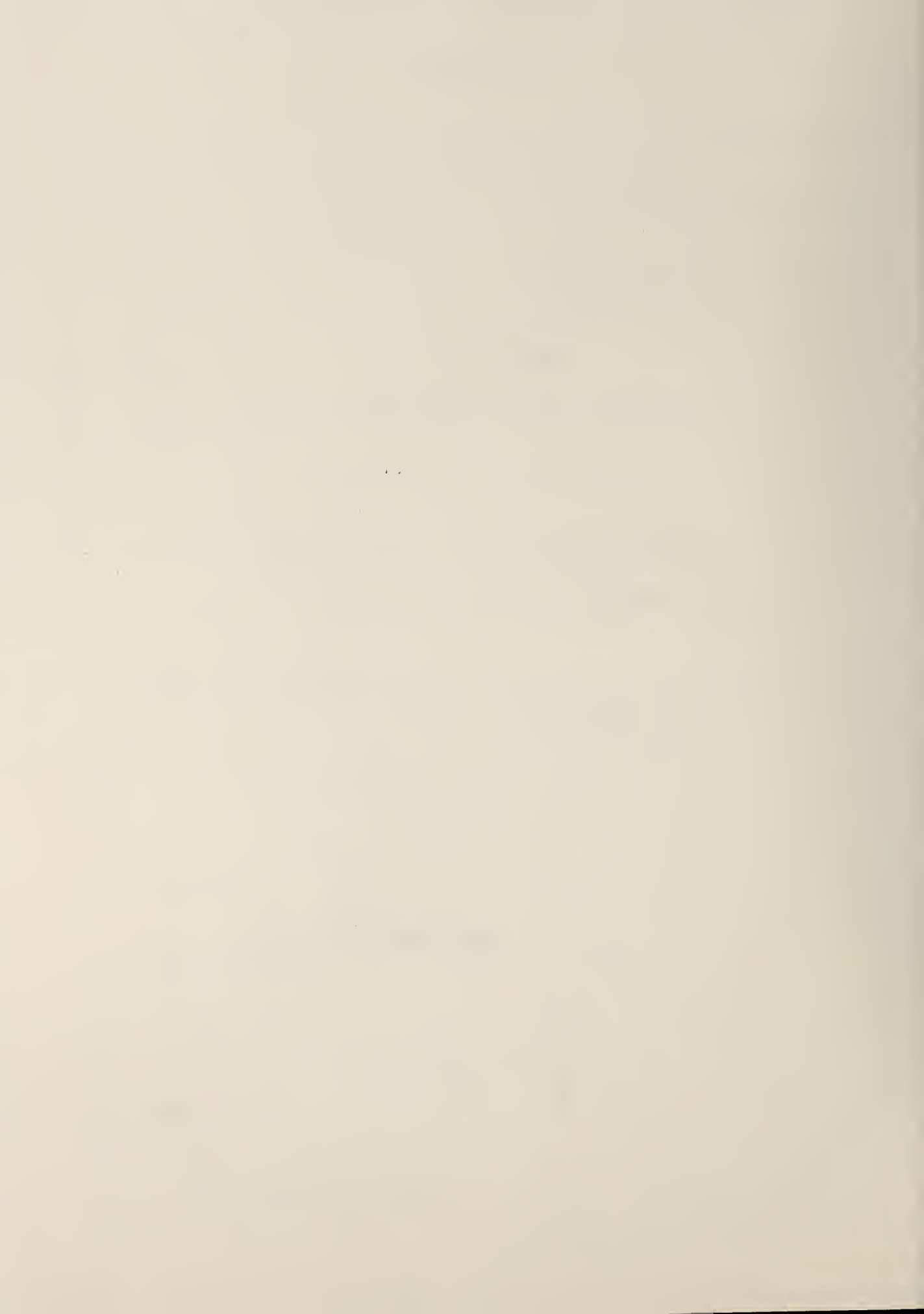


Table 1: Geographical and Statistical Summary

Locality	No. of Specimens	Length			Breadth			Height		
		Range <sup>1</sup>	Mean <sup>1</sup>	S. D. <sup>2</sup>	Range <sup>1</sup>	Mean <sup>1</sup>	S. D. <sup>2</sup>	Range <sup>1</sup>	Mean <sup>1</sup>	S. D. <sup>2</sup>
Hawaiian Is.	198	80-147	117	10.1	56- 96	80	7.14	39- 81	64	6.3
Johnston Is.	14	100-116	100	—	72- 80	77	—	55- 65	59	—
Pacific	205	51-103	77	10.2	37- 77	54	6.1	28- 57	43	5.7
Marshall Is.	32	58- 96	76	—	42- 67	53	—	33- 57	43	—
Line Is.	21	79- 95	91	—	53- 65	54	—	41- 52	41	—
Samoa	29	64-100	77	—	43- 66	54	—	35- 54	44	—
Fiji	17	60- 96	73	—	42- 64	51	—	36- 47	41	—
Marianas Is.	7	59- 93	77	—	43- 63	54	—	35- 49	43	—
Caroline Is.	52	51- 90	74	—	37- 65	49	—	28- 50	39	—
Society Is.	9	74-103	88	—	50- 77	60	—	40- 56	49	—
Philippines	38	59- 90	78	—	43- 59	54	—	35- 49	44	—

<sup>1</sup> Measurements in millimeters<sup>2</sup> Standard deviation

standpoint of linear dimensions, may be separated as a subspecies. No statistically significant differences were found for calculations of length/breadth and length/height ratios.

It is apparent from the data (Table 1 and fig. 1, Plate 8) that samples of *Cypraea tigris* from Johnston Island, which is 450 miles south of the Hawaiian Islands, fall within the size range of the Hawaiian specimens. The mean dimensions of the Johnston Island specimens are, however, slightly smaller than those of the Hawaiian sample. Because of the small sample of Johnston Island material, statistical tests for this group have not been included. However, it should be pointed out that the shells from Johnston Island resemble those from the Hawaiian Islands in color and lack a marginal callus, characters which Cate (1961b) considers distinctive of the Hawaiian subspecies. An hypothesis accounting for the occurrence of a population of *C. tigris* at Johnston Island similar to the Hawaiian population has been put forward elsewhere (Kay, manuscript in press).

A survey of the literature and discussions with shell collectors in Hawaii disclose that the habitat of *Cypraea tigris* in the Hawaiian Islands is in contrast to its habitat elsewhere in the Pacific. In the Hawaiian Islands *C. tigris* is collected from depths of eight to ten feet and deeper (with one or two records of collection at depths of four to eight feet) where it is found beneath dead coral and on basalt boulders and spits. In other areas of the Pacific the species has been described as occurring exposed on the surface of large coral heads at Biak in the Marshall Islands (Bayr and Neurohr, 1946), in association with living coral heads on reefs between the tide marks in American Samoa (Ingram, 1939), and on various lagoon and seaward reefs in the Pacific (Demond, 1957).

Specimens of *Cypraea tigris* in the Hawaiian Islands vary in size with both depth and locale. Cate (1961a) has noted that "the smaller shells seem to come from the shallower localities in the southern end of the range, medium-sized ones from the intermediate depths of mid-range, and the largest known in the world from deep-water Oahu stations." Data confirming Cate's observations are presented in figs. 2 and 3. Although measurements for specimens from the Island of Hawaii are few and inconclusive due to the unavailability of records at the present time, the data from the islands of Kauai, Oahu, and Maui indicate a tendency for the larger specimens to be more abundant around the northern islands, with the exception of the extremely large specimens which were collected from deep waters off Oahu. It is also apparent that depth of collection varies with the islands; individuals from Kauai, the northernmost of the main islands in the Hawaiian chain, having been found at depths of 25 to 40 feet, while the islands to the south yielded collections from progressively shallower water.

Two specimens of *Cypraea tigris* have been examined from islands to the north of Kauai. It is noteworthy that both, one from Midway and the other from Kure, fall into the size range of material from the Pacific, being 63 mm. and 75 mm. in length, respectively. They also exhibit the callus and color pattern characteristic of the Pacific type. The dimensions of these specimens have not been included in the analysis of data, because of their apparent similarity to individuals from the other Pacific areas.

Another interesting feature concerning *Cypraea tigris* in the Hawaiian Islands is the shortage of collections of juveniles. There are only three known juveniles from Hawaii, all three collected by Dr. C. M. Burgess. Other

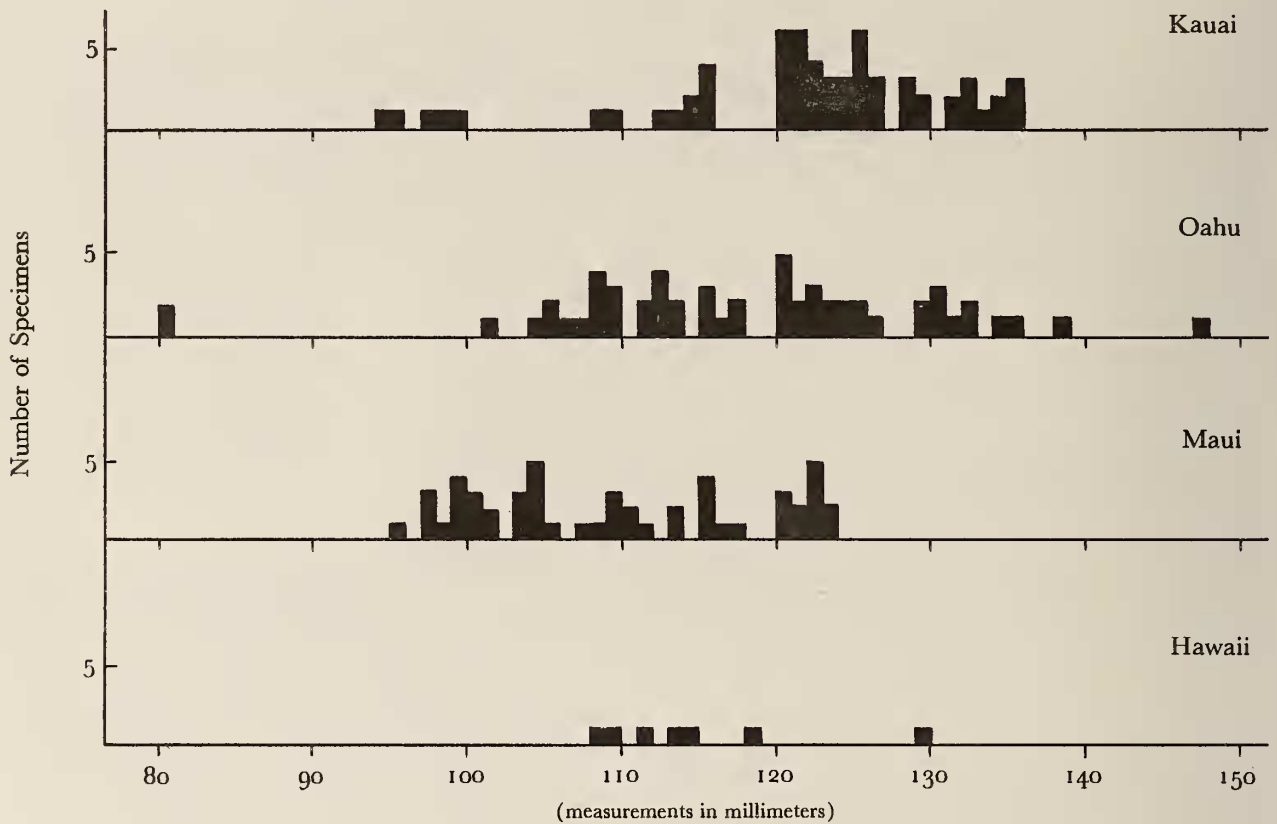


Figure 2: Length-frequency histogram showing the relationship between length and island for *Cypraea tigris* in the Hawaiian Islands

shell collectors with wide collecting experience have remarked that they have been unable to find juveniles of this species, although they are well known for other species of *Cypraea*.

The history of *Cypraea tigris* in the Hawaiian Islands is sparse. Cate (1961a) has noted that Schilder (1933) considers early records of Garrett (1879), Baldwin (1898), and Hidalgo (1906) doubtful, and Cate regards the first authentic record to be that of a specimen collected in 1929 and recorded by Harris (1935). Cate's (1961a) reference to a record cited by Martens and Langkavel (1871) is apparently an error; the reference quoted refers to *Terebra tigrina* from the Kingsmill Islands. Martens and Langkavel (1871) do not refer to *C. tigris* from the Hawaiian Islands.

Two early reports of *Cypraea tigris* in the Hawaiian Islands have recently come to the author's attention. The naturalist on the Portland and Dixon voyage to Hawaii mentions "... beautiful shells such as *Cypraea tigrina*..." from the Hawaiian Islands (Dixon, 1789). Another record is that of W. H. Pease, who described

a specimen of "... *Cypraea tigris* from your island (Hawaii) five inches in length and over nine inches around the thickest part..." in a letter to Andrew Garrett dated March 5, 1857 (Manuscript Collection, B. P. Bishop Museum, Honolulu). As the dimensions mentioned by Pease fall well within the size range of the Hawaiian specimens, it would appear that *C. tigris* had been collected in the Hawaiian Islands prior to the 20th century, although Pease notes in the same letter, "... I never obtained but few."

While there are no records of *Cypraea tigris* in the Hawaiian archaeological collections of the B. P. Bishop Museum or among fossils from the late Pleistocene, there is one fossil example of *C. tigris* which has been tentatively dated as Recent. The shell was dredged from not more than four feet below the surface of a reef near Kaaawa, Oahu, in 1948 (R. Gage, personal communication). Ostergaard (personal communication) observes that the specimen cannot be assigned an age comparable to that of the fossiliferous limestone of Oahu (usually considered Late Pleistocene) because of its position below the surface of the reef.